

NON-PUBLIC?: N  
ACCESSION #: 9002270006  
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Millstone Nuclear Power Station Unit 3 PAGE: 1 OF 04

DOCKET NUMBER: 05000423

TITLE: Manual Reactor Trip After Main Feedwater Pump Coupling Failure  
Due to Loss of Coupling Bolt Preload  
EVENT DATE: 01/18/90 LER #: 90-005-00 REPORT DATE: 02/16/90

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR  
SECTION:  
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:  
NAME: Frances M. Marshall, Engineer, TELEPHONE: (203) 447-1791  
Ext. 5400

COMPONENT FAILURE DESCRIPTION:  
CAUSE: B SYSTEM: SJ COMPONENT: CPLG MANUFACTURER: K200  
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: No

#### ABSTRACT:

On January 18, 1990, at 0803 hours, while operating in Mode 1 at 100% power, 2250 psia and 587 degrees Fahrenheit, a manual plant trip was initiated in anticipation of an automatic trip on low low level in all four steam generators.

At 0802 hours, the steam flow greater than feed flow mismatch alarm annunciated for all four steam generators, followed by steam generator low level alarms. The motor-driven feedwater pump, 3FWS-P1, did not automatically start because the feedwater pump discharge header pressure did not decrease to the automatic start setpoint. The third condensate pump, 3CNM-P1B, was started prior to starting 3FWS-P1. By the time 3FWS-P1 was manually started, the steam generator levels were too low and an automatic trip on low low steam generator trip was imminent.

The root cause of the event was the failure of the turbine/pump coupling of 3FWS-P2B due to loss of preload on the coupling bolts due to personnel and procedural errors. Contributing causes were the pump and turbine misalignment, and inadequate coupling lubrication. In order to prevent a recurrence of feedwater pump coupling failure, changes have been made to the coupling installation procedure and the vibration alarm setpoint will be lowered.

END OF ABSTRACT

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#### I. Description of Event

On January 18, 1990, at 0803 hours, while operating in Mode 1 at 100% power, 2250 psia and 587 degrees Fahrenheit, the operating Shift Supervisor (SS) ordered a manual plant trip to be initiated in anticipation of an automatic trip due to low low level in all four steam generators.

At 0802 hours, the steam flow greater than feed flow mismatch alarms annunciated for all four steam generators, followed by steam generator low level alarms for all four steam generators. A licensed control operator (CO) placed the main turbine-driven feedwater pump master speed controller in manual to increase the flow. The motor-driven feedwater pump, 3FWS-P1, did not automatically start because the feedwater pump discharge header pressure did not decrease to the automatic start setpoint. The third condensate pump, 3CNM-P1B, was manually started prior to manually starting the motor driven feedwater pump, 3FWS-P1. By the time 3FWS-P1 was started, the steam generator levels were too low and an automatic trip on low low steam generator level trip (18%) was imminent. At 20% level, the SS ordered the plant to be manually tripped. An Assistant Maintenance Supervisor reported that the turbine/pump coupling to the 'B' turbine driven feedwater pump, 3FWS-P2B, had failed. This was the first indication of the cause of the low feedwater flow. A non-licensed operator (PEO), while on routine rounds, had inspected the feedwater pumps approximately 5 minutes prior to the coupling failure, and had found no unusual noise or vibration.

The operators verified that both reactor trip breakers opened, that all rods were at the bottom and that neutron flux was decreasing. A turbine trip followed the reactor trip. A feedwater isolation occurred, which is a normal plant response to a reactor trip and low average reactor coolant system temperature. No other safety signals

were expected or received. There were no operational, maintenance, or construction activities in progress at the time of the event that affected the event. There were no safety systems out of service or in off-normal status at the time of the event. A steam generator blowdown sampling isolation valve, 3SSR\*CTV19B, did not indicate closed on the main board after the trip. This valve is required to shut on an auxiliary feedwater pump start on low low steam generator level to minimize flow from the steam generators. Investigation revealed that the valve was in fact closed, and the indication problem was due to the limit switch on the valve. The switch was readjusted, the valve was retested and declared operable. There were no other failures of safety-related equipment. Plant stability, based on reactor coolant average temperature, was achieved at 1015 hours.

A review of the vibration data revealed that there was an upward trend in the monthly vibration checks, yet overall vibration levels did not reach either the alert or alarm setpoints. The vibration recording for the 3FWS-P2B inboard shaft indicated an upward trend from 2 1/2 mils to 5 1/2 mils during the 8 hours prior to the coupling failure. No alarm was received because the setpoint was at 7 mils.

It was noted that there was no overspeed trip of 3FWS-P2B after the coupling failure. The RPM of the turbine did not noticeably increase above the normal running speed after the failure. The normal mechanical hydraulic control (MHC) speed controller handled the loss of load by modulating closed the steam control valves, so the pump never reached its mechanical overspeed setpoint.

## II.

### Cause of Event

The reason for the plant trip was the failure of the turbine/pump coupling of the 'B' turbine driven main feedwater pump, 3FWS-P2B. Investigation of the coupling failure revealed that the primary root cause of the failure was loss of preload on the coupling bolts, due to personnel error and procedural inadequacy.

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### II. Cause of Event (Continued)

Analysis of the failure has determined that catastrophic failure of the coupling would probably, have not occurred if the coupling bolts had not lost preload. The procedural inadequacies were that:

- a) The torque values for the coupling bolts were not specified in the applicable procedure. Instead the procedure referenced the vendor technical manual.
- b) The torque values specified by the vendor in the vendor technical manual were inadequate.
- c) The coupling bolts were installed backwards due to inadequate guidance on correct orientation.

The personnel error was that some of the bolts installed had bolt shanks which were too long. This caused insufficient thread engagement. Per standard maintenance practice, maintenance personnel should have been aware of the proper bolt shank length.

In addition, investigation of the incident identified misalignment between the pump and turbine, and inadequate coupling lubrication. Although not direct causes, these factors may have been contributory to the coupling failure. Misalignment was indicated by coupling tooth wear patterns and by alignment readings taken following the failure. Inadequate coupling lubrication was apparent upon coupling examination. The existing grease was caked and partially separated, and the amount of grease was inadequate.

## II. Analysis of Event

This event is reportable under 10CFR50.73(a)(2)(iv), any event or condition that resulted in manual or automatic actuation of any Engineered Safety Feature.

There were no significant safety consequences due to this event. The component that failed, 3FWS-P2B, is not required to perform any safety function, nor did its failure prevent any of the plant's safety systems from performing their intended safety functions. Failure of the main board indication for 3SSR\*CTV19B did not affect the safety function of the valve, since the valve was tested and determined to be closed.

## IV. Corrective Action

Once the plant had been stabilized in hot shutdown, the 'A' turbine driven main feedwater pump, 3FWS-P2A, was disassembled, cleaned, inspected, lubricated, and realigned prior to starting up the plant.

In order to ensure adequate bolt preload, proper lubrication and

alignment, the following actions have been or will be taken:

1. All couplings will be cleaned, inspected, and new grease installed. This has been completed on the two operating pumps, 3FWS-P2A and 3FWS-P1, and will be performed on 3FWS-P2B during coupling installation.
2. All coupling bolts have been replaced on all three main feedwater pumps, and were installed in the proper orientation. Once 3FWS-P2B is operating, the other pumps will be removed from service and the bolts retorqued. Until then, vibration will be closely monitored for evidence of coupling problems.

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#### IV. Corrective Action (Continued)

3. Coupling bolts will be measured to ensure adequate thread length. This has been completed on 3FWS-P1, and will be done on 3FWS-P2B prior to installation of the coupling, and on 3FWS-P2A when the bolts are retorqued.

Actions that have been or will be taken to prevent a recurrence of feedwater pump coupling failure are the following:

1. The coupling installation procedure has been rewritten to include bolt shank measurement, increased bolt torque values, grease amount, and bolt orientation details.
2. Preventative Maintenance workorders have been generated to replace coupling grease and perform alignment checks every refueling outage.
3. The feedwater pump turbine bearing vibration alert and alarm setpoints will be lowered prior to the third refueling outage.

The concerns over adequate coupling bolt shank length will be discussed with Maintenance personnel at a Department Meeting. This action will be completed by March 16, 1990. All corrective actions and actions to prevent recurrence are scheduled to be completed by the end of the third refueling outage.

#### V. Additional Information

There have been no similar events with the same root cause and sequence of events.

The "B" turbine driven feedwater pump, 3FWS-P2B is a Byron-Jackson, Model Number 20X20X18B-HDR.

EIIS Codes

System

Main Feedwater System - SJ

Component

Pump - P

Coupling - CPLG

Valve -V

ATTACHMENT 1 TO 9002270006 PAGE 1 OF 1

NORTHEAST UTILITIES

NU The Connecticut Light and Power Company

Western Massachusetts Electric Company

Holyoke Water Power Company

Northeast Utilities Service Company

Northeast Nuclear Energy Company

General Offices Selden Street, Berlin Connecticut

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February 16, 1990

MP-90-176

Re: 10CFR50.73(2)(2)(iv)

U.S. Nuclear Regulatory Commission

Document Control Desk

Washington, D.C. 20555

Reference: Facility Operating License No. NPF-49

Docket No. 50-423

Licensee Event Report 90-005-00

Gentlemen:

This letter forwards Licensee Event Report 90-005-00 required to be submitted within thirty (30) days pursuant to 10CFR50.73(a)(2)(iv), any event or condition that resulted in manual or automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protection System (RPS).

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

FOR: Stephen E. Scace  
Director, Millstone Station

BY: Harry F. Haynes  
Millstone Unit Services Director

SES/FMM:mo

Attachment: LER 90-005-00

cc: W.T. Russell, Region I Administrator  
W.J. Raymond, Senior Resident Inspector, Millstone Unit Nos. 1, 2  
and 3  
D.H. Jaffe, NRC Project Manager, Millstone Unit No. 3

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